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MAINE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 2.

SECOND SERIES.

THE APPLE MAGGOT.

Trypeta pomonella, Walsh.

PROF. F. L. HARVEY.

(Prof. Harvey has, by nearly two years patient labor, the results of which will appear in a more elaborate and detailed form later, completely worked out the life history of the apple maggot, which is doing such immense injury to fruit in some parts of our State. The practical points of his researches are herewith presented. In securing these results the Station has done its part of the work. The fruit growers must do the rest. If the recommendations which Prof. Harvey makes could be faithfully and universally followed for two years, there would be few traces of the apple maggot left in the State. Concerted and vigorous action on the part of fruit growers is needed.

W. H. JORDAN, Director.)

Last season quite extended and careful observations were made to determine the habits of this troublesome insect and many interesting and novel facts gathered pertaining to its life changes. This summer the studies have been continued and the observations of last season so supplemented and verified that we are now able to announce all the steps in its complete life history. The details of work by which these results were obtained will be fully considered and illustrated in a subsequent bulletin. The object now is to give tersely the steps in the life history of the insect, call attention to the weak and strong points in its life changes, indicate useless methods of coping with it and suggest such preventive and direct remedial measures as are likely to check its ravages.

LIFE HISTORY.

The *perfect insect* is a two-winged fly somewhat smaller than the house fly.

It was briefly described in the Annual Report of the Experiment Station, 1888, page 175. The figure there given of the female shows the general nature of the fly, though incorrect in some details.

The flies appear in this State early in July and continue to emerge from the ground for about six weeks or two months. They soon begin to deposit eggs in the early apples, which are at that time from one-half to two-thirds grown. The later flies affect the later varieties.

Each female is capable of depositing over 300 eggs, which are inserted from time to time, one in a place, by means of a sharp ovipositor, through the skin of the apple. The maggots hatch in a few days and become full grown in four to six weeks when they are one-fourth inch long. They tunnel or "railroad" the pulp of the apple rendering it worthless.

The larvæ remain in the apples until they are ripe and occur as abundantly in the windfalls as in the hanging fruit. Larvæ of several ages may be found in the same fruit. Soon after they are mature the larvæ leave the apples through characteristic irregular openings in the skin, and if conditions are favorable, go into the ground an inch or less, or on sod ground, they remain about the grass roots. In a short time they change to the pupa state and remain in that condition until the next season when the flies emerge again. There is no evidence whatever of a second brood. The larvæ contained in stored fruit leave it and go into the pupa state in the barrels or bin, and under favorable conditions probably come out the following spring.

REMEDIES.

USELESS METHODS.

1. Spraying early in the season when the apples are small would do no good as the flies are not on the wing until July, when the early fruit is fully half or two-thirds grown, and too large to spray with safety.

2. Though in confinement the flies are very fond of sugar, yet

sweets poisoned with arsenious acid and corrosive sublimate, and placed on paper in shallow pans in the trees, failed to attract them.

3. Sticky fly papers seem to be useless. We exposed several sheets in the branches of a tree where the flies were thick, for three days, and only took a *single* Trypeta fly.

PREVENTIVE MEASURES.

1. Keep the orchards in grass and in the fall or spring burn under the trees to destroy the pupæ that are about the grass roots.

2. If the orchard is in cultivation the conditions are favorable for the maggots to go into the ground, but they never go deeper than an inch and deep spading or plowing in the spring would destroy them.

3. Orchards on sandy soil and in sheltered places with a southern exposure are worse affected. In planting orchards such conditions might be avoided.

4. Prevent by legal enactment the importation of foreign fruit from localities known to be infested. The pest was undoubtedly introduced into the State by importation of foreign apples. And each year there is a new invoice from Mass. in *imported early fruit*. We saw in the Orono market to-day a barrel of early sweet apples from Mass. literally alive with nearly full grown *Trypeta maggots*. No matter what methods are adopted to check this pest they will prove futile if each year in all the towns of the State maggots by the hundreds are thrown upon the ground in worthless infested foreign fruit.

DIRECT METHODS.

1. The flies are very stupid although they appear otherwise. When resting on the leaves or apples they can readily be taken with a small insect tube or bottle. By placing the mouth cautiously over them, they are not disturbed, and soon crawl inside. We took thirty this way from a single tree in an hour and a half. Making no allowance for mishaps and supposing a fly lays three hundred eggs and one-half of the flies are females, the progeny of a single fly the third season would be capable of laying nearly seven million eggs. The killing of even a few flies would materially lessen the number and hold the pest in check.

2. The fact that the larvæ do not leave the fruit before it is ripe and are still found in abundance in the windfalls, would indicate the most vulnerable points in the life history of the insect and suggest two methods of checking the pest, viz.: Taking

care that the larvæ in the gathered fruit be not allowed to transform, and destroying the windfalls. The apples gathered for home consumption and for market may contain many maggots, as our observations show the larvæ are still in the fruit when ripe. The chances that these larvæ find the conditions for development are much less than with those that go into the ground from the windfalls, but the pest may be spread through marketed fruit or be perpetuated from fruit stored or used at home.

a. Infested apples in market places are a fruitful source of the pest, and fruit dealers should be required to burn or bury all apple refuse and not throw it on the ground.

b. The maggots in stored apples soon leave them and go into the pupa state in the barrels or bins. If marketed the pupæ go with the fruit in the barrel and may spread the pest. In bins and barrels in the cellar the pupæ no doubt retain their vitality and the flies emerge in the spring. As a precaution the bins should be carefully swept and the barrels shaken into a tight vessel and the refuse buried or burned. Apple refuse from home use should be destroyed and not thrown on the ground.

c. The maggots are not able to crawl out of a box and the refuse from market places, &c., could be thrown into a tight box or barrel and the maggots prevented from going into the ground. The refuse could occasionally be buried a foot or so deep.

3. Thorough and universal destruction of the windfalls is the most hopeful means of checking the pest. To carefully gather the fallen fruit every day from the early and later varieties from Aug. 1st until Nov. 1st and burn or feed it, would destroy many of the maggots. Sheep or hogs might be allowed the range of the orchard to eat the windfalls. *To leave the windfalls on the ground would favor the most rapid multiplication of the pest.* It is some trouble to gather the windfalls but it would be little compared with the benefits derived, if the pest can be checked. This fly annually destroys much fruit in some parts of the State and its ravages are increasing, and it threatens, unless checked, to be the most serious pest to apple growers. Its ravages are somewhat circumscribed but it will spread unless checked. Such a serious enemy needs concerted and determined action. The importance of rigidly adhering to this method for at least two years cannot be to strongly urged upon fruit growers whose orchards are infested.

4. If the above methods do not succeed there is a radical one that cannot fail. The destruction of the entire apple crop for one

season in the infested districts of the State by giving the flies no place to rear their maggots would about destroy the pest. We do not think this will be necessary if the careful destruction of windfalls and infested fruit is practiced. Should such a radical means be necessary the flies could be allowed to deposit their eggs and the fruit approach maturity when it could be gathered and fed and not prove a serious loss.

SUMMARY.

1. Thoroughly and promptly destroy all refuse from infested fruit, apple pomace, waste about the house, etc.

2. Promptly destroy windfall apples and infested fruit.

3. Destruction should be immediate after the first of August, and nothing short of deep burying, burning or feeding to swine or cattle will be effective.

4. These precautions should be universally adopted.

5. The sale or importation of infested fruit should be prohibited.

THE POTATO ROT.

PHYTOPHTHORA INFESTANS, DEBARY.

(*Peronospora infestans*, *Mont.*)

PROF. F. L. HARVEY.

We are daily receiving specimens of potato tops and leaves badly infested with the above disease, and believe the information given below will be of general interest.

LIFE HISTORY.

This fungus lives over winter in the form of resting or winter spores (oosporæ) which are found in the stems, leaves and tubers. The stems and leaves decay leaving the resting spores which retain their vitality in the ground, and from these, or from spores in the tubers, the disease starts the following spring. The fungus is deep seated in the stem and leaves of the potato, and later affects the new tubers. During the summer and fall it appears on the surface as a white mildew, which upon examination will be found composed of branching pedicils (conidiophores), bearing numerous minute white oblong bodies, the summer spores (conidia) of the fungus. These summer spores are carried by the wind to other parts of the field, light on the plants, germinate, enter and augment the disease. During the summer, new winter spores are formed within the stems, leaves and tubers, completing the life history.

REMEDIES.

The methods of treatment are direct and preventive, from the fact that the parasite is internal and only appears at the surface while producing summer spores. The methods must be largely preventive.

DIRECT METHODS.

Any means by which the growth of the *summer spores* can be checked, would prevent the spread of the disease from plant to plant during the season, and prove beneficial.

The following solutions have been tried in France and in New Jersey with apparently satisfactory results and we would recommend them for trial in Maine:

SOLUTIONS.

No. 1.—Mix 1 qt. of strong ammonia water (hartshorn) with 3 ozs. of carbonate of copper. Stir rapidly until a clear liquid is produced. When ready to use it, dilute to 22 galons with water. Apply with a spraying apparatus or force pump.

No. 2.—Dissolve 1 lb. sulphate of copper (blue stone) in 2 gallons of hot water. When dissolved and cool add 1 1-2 pints of commercial ammonia water. Dilute to 22 gallons with water. Apply as stated above.

No. 3.—Dissolve 6 lbs. copper sulphate in 16 gallons water. Shake 4 lbs. of fresh lime into 6 gallons of water. When cool mix the above solutions slowly and thoroughly and apply as stated above.

NOTE.

Any spraying apparatus will answer. Select the recipe for which the material can be readily obtained. Spray as soon as the disease begins to show as a whitish mildew, or the leaves begin to blacken. We would be pleased to have a report from those who try these mixtures.

PREVENTIVE METHODS.

1. Burn the tops and leaves in the fall after the crop is gathered, to destroy the winter spores contained in them.
2. Gather all the small potatoes, for if allowed to decay in the field the winter spores in them will start the disease the

following summer.

3. Select seed for planting, if possible, from fields or localities exempt from the disease the previous season.

4. Rotate the potato crop, as the winter spores germinate the following spring and finding no food-plants must perish.

5. Burn all decayed potatoes taken from the cellar or bins and other potato refuse—do not throw them on the compost heap as the spores retain their vitality and are spread far and wide with the manure.

6. The winter spores do not germinate very early in the spring. The planting of early varieties that mature before the parasite can get a start, has been recommended.

7. If cut seed is used, the surface should be allowed to dry, for when placed in the ground the winter spores would find ready entrance to the tubers through the freshly cut surface.

REMARKS.

If varieties of potatoes can be found less liable to attack they should be selected. We believe that a *faithful* and *universal* observance of the preventive methods suggested will go far toward relieving potato growers of this pest. We would like to hear from any into whose hands this bulletin may fall as to whether preventive methods are practiced.